# Maintenance Instructions
# And
# Parts List

# MAJOR MEGGER
# INSULATION TESTER

## Cat. No. 21158

James G. Biddle Co.
Plymouth Meeting, PA 19462

BDDL 10/21/03 LA

TABLE OF CONTENTS


| Par. | | Page |
|---|---|---|
| | SECTION 1. GENERAL INFORMATION | |
| 1.1 | Equipment illustration - see Figure 1 | 1 and 2 |
| 1.2 | Functional Description | 2 |
| 1.3 | Reference Data | 3 |
| | SECTION 2. INSTALLATION | |
| 2.1 | Unpacking and Handling | 4 |
| 2.2 | Installation | 4 |
| 2.3 | Inspection and Adjustment | 4 |
| | a. Check Infinity | 4 |
| | b. Check Zero | 4 |
| | c. Check Testing Leads | 4 |
| | SECTION 3. OPERATION | |
| 3.1 | Functional Operation - see Manual 21J | 5 |
| | a. Use | 5 |
| | b. Capabilities and Limitations | 5 |
| | c. Ohmmeter Movement | 5 |
| | d. Test Leads | 5 |
| 3.2 | Preparation for Use | 5 |
| 3.3 | Preparing Apparatus to be Tested | 5 and 6 |
| 3.4 | Connections - see Manual 21J | 6 |
| | SECTION 4. PRINCIPLES OF OPERATION | |
| 4.1 | Overall Functional Description | 7 |
| 4.2 | Functional Sections | 7 |
| | a. Indicator | 7 |
| | b. Generator | 7 |
| | c. Gear Train | 7 |
| | d. Resistance Network | 7 |
| 4.3 | Calibration | 7 |
| | a. Test Equipment - see Table 5-3 | 13 |
| | b. Ohm Scale | 7 |
| | c. Megohm Scale | 8 |
| | d. Discharge | 8 and 9 |
| | e. Voltage | 9 |
| | SECTION 5. TROUBLE-SHOOTING AND MAINTENANCE | |
| 5.1 | Troubleshooting | 10 |
| 5.2 | Troubleshooting charts | 10, 11, 12 |
| 5.3 | Table 5-3 Calibration Equipment | 13 |
| 5.4 | Removal of Parts and Subassemblies | 14 |
| | a. Removal of Case Cover | 14 |
| | b. Removal and Disassembly of Moving Element Assembly with scale | 14 |
| | c. Removal of Generator | 15 |
| | d. Removal of Component Board Assembly Resistors and Capacitors | 16 |
| | e. Removal of Switch | 16 |

TABLE OF CONTENTS


| Par. | | Page |
|---|---|---|
| | SECTION 5. TROUBLE-SHOOTING AND MAINTENANCE | |
| 5.5 | Reassembly of Parts and Subassemblies | 17 |
| | a. Replacement of Component Board Assembly | 17 |
| | b. Replacement of Generator | 17 |
| | c. Reassembly and Replacement of Moving Element Assembly with Scale | 17 |
| | d. Replacement of Case Cover | 17 |
| | SECTION 6. PARTS LIST | |
| Fig. | | |
| 6.1 | Schematic Diagram | 18 |
| 6.2 | Photo, Case bottom-case cover | 19 |
| 6.3 | Photo, Chassis, Switch and Potentiometer | 20 |
| 6.4 | Photo, Component Board | 21 |
| 6.5 | Photo, Generator and Moving Element | 22 |
| 6.6 | Parts List | 23, 24 |
| | SUPPLEMENTARY MATERIAL | |
| | Manuals 21-50J, 21J and 21-P8 | |

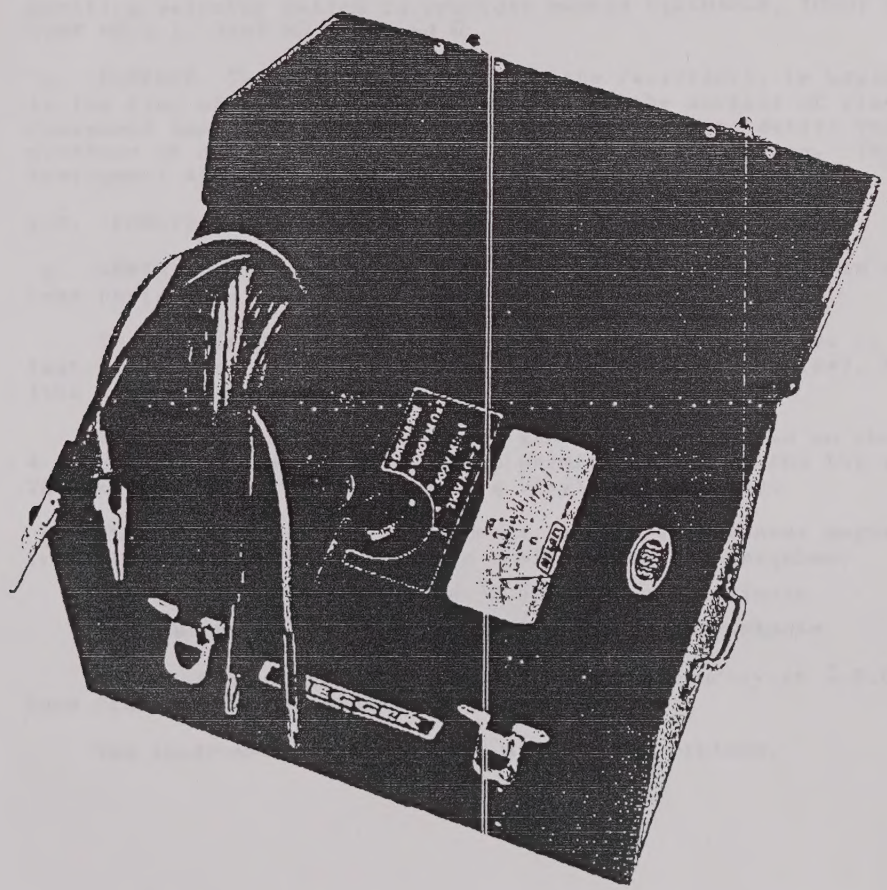



Fig. 1 Instrument, Case, Leads

SECTION 1

GENERAL INFORMATION

1-1. EQUIPMENT ILLUSTRATION. (See figure 1)

a. GENERAL. The Major Megger Insulation Tester described herein is comprised of a hand-driven generator with voltage rectified to 250, 500 and 1000 volt dc, a cross coil movement with 0-20,000 Ω and 0-1000 MΩ scales, a Carrying Case and Test Leads. The five position selector switch is provided marked DISCHARGE, 1000V MΩ x 2, 500V MΩ x 1, 250V MΩ ÷ 2, and Ω.

b. PURPOSE. The instrument measures the resistance, in megohms, to the flow of current through and/or over the surface of electrical equipment insulation. The test results are used to detect the presence of dirt, moisture, and insulation deterioration. The instrument also measures resistances up to 20,000 ohms.

1-2. FUNCTIONAL DESCRIPTION.

a. GENERAL. The instrument is portable. It is enclosed in a metal case resting on four rubber feet.

The ohmmeter movement is mounted at one end, opposite to the test terminals, or binding posts, marked GUARD (crank side), LINE (the center terminal), and EARTH.

The crank for the hand-driven generator is mounted on the side. A window is provided at the top to permit reading of the two scales. The instrument is transported in a vinyl carrying case.

b. OHMMETER. The ohmmeter movement is of the permanent magnet cross-coil pointer type with two scales - ohms and megohms.

The megohm scale length - 2.50 inches approximate

The ohm scale length - 2.375 inches approximate

The instrument is calibrated to have an accuracy of $\pm$ 0.03 inch from any marked position.

The instrument to be cranked at 160 RPM, minimum.

1-3. QUICK REFERENCE DATA

a. Maximum Dimensions.

(1) Length.....7.0 inches

(2) Width.....4.5 inches

(3) Height.....5.0 inches

b. Type of Operation.....Hand Cranked

c. Operating Temperature.....5° to 45° C
41° to 113° F

d. Voltage, open circuit, at 160 RPM minimum cranking speed....1000V to 1050V DC
500V to 550V DC
250V to 275V DC

e. Voltage change at infinity (between cranking speeds 180-240 RPM).. ± 3%

f. Resistance ranges, maximum.....0-2000 megohms at 1000V
0-20000 ohms

g. Accuracy..... ± 0.030 inch

## SECTION 2

## INSTALLATION

2-1. UNPACKING AND HANDLING.

To prepare the instrument for use, remove outer wrapping and lift out of its case with the 12-foot test leads.

2-2. INSTALLATION.

The instrument is a portable unit used only for testing purposes and no permanent installation is necessary.

2-3. INSPECTION AND ADJUSTMENT.

Use the instrument in its carrying case on a firm and fairly level base. Avoid large masses of iron and magnetic fields.

NOTE:

THE INSTRUMENT IS NOT EQUIPPED WITH EXTERNAL POINTER ZEROING. THE MOVEMENT BEING A TRUE OHMMETER, THE POINTER WILL REST ANYWHERE ON THE SCALE.

a. CHECK ∞ (INFINITY). With no connections to the binding posts, check infinity by turning crank at 160 RPM minimum. The pointer should read ∞ (infinity) (when switch is set at any position except Ω or discharge) within accuracy ± 0.030 inch.

b. CHECK 0 (ZERO). Short circuit EARTH and LINE binding posts. Turn crank at 160 RPM minimum. The pointer should read 0 (zero) (when switch is set at any position except DISCHARGE), within accuracy ± 0.030 inch.

c. CHECKING TESTING LEADS. With test leads connected to the EARTH and LINE binding posts and with opposite ends separated, turn the crank at about 160 RPM minimum. If the pointer indicates less than infinity (greater than 0 ± 0.030 inch) there is a leak between the leads which must be removed before instrument can be used. Touch together the test ends of the leads while turning the crank to make certain, by a zero reading, that the leads are not open-circuited.

## SECTION 3

## OPERATOR'S SECTION

3-1. FUNCTIONAL OPERATION. (Additional Instructions-Manual 21J.)

a. USE. The instrument is to be used in checking the insulation resistance of electrical installations and components. These tests are to be made for acceptance and test of equipment, for maintenance checks, or to determine faulty wiring.

b. CAPABILITIES AND LIMITATIONS. The instrument is designed to make insulation resistance tests between:

0- 500 megohms at 250 volts
0-1000 megohms at 500 volts
0-2000 megohms at 1000 volts

The potential applied to the apparatus under test will vary from zero to maximum voltage depending on the resistance of the item being tested and the internal resistance of the instrument that is in series with the EARTH binding post, (see figure 6-1).

WARNING!

DO NOT USE INSTRUMENT ON APPARATUS FOR WHICH THE MAXIMUM TEST VOLTAGE IS UNSAFE.

c. OHMMETER MOVEMENT. (See figure 6-5). Is of the permanent magnet, moving cross coil and pointer type with a scale length of about 2.5 inches. It is calibrated to within ± 0.030 inch of any marked position. The ohm scale length is about 2.375 inches.

d. TEST LEADS. 12-foot test leads are provided with the instrument, any convenient length may be used. The test leads have jack termination at one end for attaching to the instrument's binding posts, and at the opposite strong spring clips for connecting to the equipment or circuit under test.

3-2. PREPARATION FOR USE.

Before using instrument, check zero and infinity and check test leads. Follow procedure outlined in paragraph 2-3.

3-3. PREPARING APPARATUS TO BE TESTED.

a. Shut down apparatus.

b. Open switches.

c. De-energize.

WARNING!

WHEN TAKING APPARATUS OUT OF SERVICE, BLOCK OUT DISCONNECT SWITCHES. APPLY NEUTRAL OR PROTECTIVE (WORKMAN'S) GROUNDS.

d. Disconnect apparatus from other equipment and circuits. Avoid removing protective grounds by disconnecting the equipment from the exposed bus or line, leaving the latter grounded.

e. If neutral or other ground connections must be disconnected, ascertain that they are not carrying current at the time, and that when disconnected no other equipment will lack necessary protection.

f. Inspect conductors which lead away from the circuit being tested to be sure that they have been disconnected properly from any source of voltage.

g. Inspect apparatus to be tested in order to determine what equipment is connected and will be included in the test. The more equipment included in the test, the lower the reading will be, and the true insulation resistance of the equipment under test may be masked by the insulation resistance of the associated equipment.

h. Ascertain that capacitance in apparatus is discharged before proceeding with test. Connect together and ground separate windings for 10 to 15 minutes immediately before a test so that insulation resistance readings are not affected by stored energy.

i. When apparatus is shut down for the insulation resistance test, make sure that the readings are not affected by leakage over or through switches or fuse blocks, etc. Such leakage may cause inaccurate test results. Inconsistent readings can be caused by current leaking from an energized line into the apparatus particularly if the live line is direct current. Such leakage can be detected by watching the ohmmeter pointer at the moment the test leads are connected to the equipment to be tested.

3-4. CONNECTIONS. See details in Instruction Manual 21J.

## SECTION 4

## PRINCIPLES OF OPERATION

### 4-1. OVERALL FUNCTIONAL DESCRIPTION.

The instrument consists of an indicator calibrated directly in terms of ohms and megohms, and AC generator with gear train, with rectifying and resistance networks. A fold-a-way crank is provided for operating the generator.

### 4-2. FUNCTIONAL SECTIONS.

a. INDICATOR. The indicator is of the permanent magnet cross coil type. When current and voltage are applied to the indicator the pointer deflects. The amount of deflection is determined by the circuit components and the unknown resistance.

b. GENERATOR. The alternating current generator consists of a single stator coil and a bi-pole permanent magnet rotor. It is rectified to direct current through a voltage doubler rectifying circuit. The rotor runs in bearings which are permanently lubricated.

c. GEAR TRAIN. The gear train is a simple internal ring gear drive with two hilical pinions. Proper lubrication of the gear train is made by the manufacturer and no additional lubrication is required.

d. RESISTANCE NETWORK. Figure 6-1 shows schematic diagram of instrument.

### 4-3. CALIBRATION.

a. TEST EQUIPMENT. (see table 5-3.)

b. OHM SCALE. To check ohm scale, proceed as follows: (proper cranking speed 160 RPM minimum see 2.3b.)

(1) Set selector switch in Ω.

(2) Connect 100 ohm resistor across the EARTH and LINE binding posts.

(3) Apply voltage by turning crank at 160 RPM minimum.

(4) Read Ω scale. Pointer should indicate 100 ohms ± 0.030 inch. Disconnect 100 ohm resistor.

(5) Repeat (2) to (4), with resistors of 500 Ω, 5 KΩ, and 20 KΩ.

c. MEGOHM SCALE. To check megohm scale, proceed as follows: (proper cranking speed 160 RPM minimum).

(1) Connect one megohm resistor across the EARTH and LINE binding posts.

(2) Set selector switch to 1000 V MΩ x 2.

(3) Apply voltage by turning crank at 160 RPM minimum.

(4) Read MΩ scale. Pointer should indicate 0.5 MΩ ± 0.030 inch.

(5) Set selector switch to 500 V MΩ x 1.

(6) Apply voltage by turning crank at 160 RPM minimum.

(7) Read MΩ scale. Pointer should indicate 1.0 MΩ ± 0.030 inch.

(8) Set selector switch to 250 V MΩ ÷ 2.

(9) Apply voltage by turning crank at 160 RPM minimum.

(10) Read MΩ scale. Pointer should indicate 2.0 MΩ ± 0.030 inch.

(11) Repeat above with resistor of 10 MΩ, 100 MΩ and 1000 MΩ.

(12) Tabling the above (1) to (11) inclusive:

| | Standard Resistors | | | |
|---|---|---|---|---|
| Selector Switch | 1 MΩ | 10 MΩ | 100 MΩ | 1000 MΩ |
| | All scale reading ± 0.030 inch. | | | |
| 1000 V MΩ x 2 | .5 MΩ | 5 MΩ | 50 MΩ | 500 MΩ |
| 500 V MΩ x 1 | 1.0 MΩ | 10 MΩ | 100 MΩ | 1000 MΩ |
| 250 V MΩ ÷ 2 | 2.0 MΩ | 20 MΩ | 200 MΩ | --- |

NOTE

IN REFERENCE TO b. AND c. THE STANDARD RESISTORS THAT WERE SELECTED COVER MANY POINTS OF THE Ω AND MΩ SCALES, BUT OTHER RESISTORS OF DIFFERENT VALUES CAN BE USED TO MEET A PARTICULAR REQUIREMENT OR NEED.

d. DISCHARGE.

(1) Set selector switch to discharge.

(2) Connect an ohmmeter with suitable ohm scale to the EARTH and LINE binding posts.

(3) Read the ohmmeter scale. Resistance should be 112 K ohms.

NOTE

THE RESISTANCE MAY BE WITHIN ± PERCENT OF 11 K OHMS.

e. VOLTAGE.

(1) Set selector switch to 1000 V MΩ x 2.

(2) Connect electrostatic voltmeter across EARTH and LINE binding posts.

(3) Apply voltage by turning crank at 160 RPM minimum.

(4) Read voltmeter. Should indicate 1000 V to 1050 V DC.

(5) Repeat (1) to (4) with selector switch set to 500 V MΩ x 1 and 250 V MΩ ÷ 2.

(6) Tabling the above (1) to (5) inclusive:

| Selector Switch | Electrostatic voltmeter reading - DC |
|---|---|
| 1000 V MΩ x 2 | 1000 V to 1050 V |
| 500 V MΩ x 1 | 500 V to 550 V |
| 250 V MΩ ÷ 2 | 250 V to 275 V |

## SECTION 5

## TROUBLE-SHOOTING AND MAINTENANCE

### 5-1. TROUBLE-SHOOTING.

TABLE 5-2. TROUBLE-SHOOTING CHART

| TROUBLE | PROBABLE CAUSE | REMEDY |
|---|---|---|
| Pointer does not move to infinity when voltage is applied during infinity check. | Defective moving element. | Replace defective moving element assembly. (See paragraph 5-4b.) |
| | Resistors $R_2$, $R_3$ or $R_4$ open. | Remove and replace defective resistors. (See paragraph 5-4d.) |
| | Capacitor C1 shorted. | Remove and replace defective capacitor. (See paragraph 5-4d.) |
| | Defective generator assembly. | Remove and replace defective generator assembly. (See paragraph 5-4c.) |

TROUBLE-SHOOTING CHART (Continued)

| TROUBLE | PROBABLE CAUSE | REMEDY |
|---|---|---|
| Pointer indicates less than infinity when test leads are connected at terminals, with opposite ends separated, and crank is turned at normal speed (160 RPM minimum). | Leakage between test leads | Correct leakage or replace test leads. |
| Pointer does not move promptly to zero. | Resistor | Remove and replace defective resistors. (See paragraph 5-4d.) |
| When switch is set at: | Open | |
| 1000 V | $R_8$, $R_7$, $R_6$, $R_5$, or $R_{14}$ | |
| 500 V | $R_7$, $R_6$, $R_5$, or $R_{14}$ | |
| 250 V | $R_6$, $R_5$, or $R_{14}$ | |
| Ohm scale Ω | $R_{10}$ | |
| | Defective moving element. | Replace defective moving element assembly. (See paragraph 5-4b.) |
| Pointer does not indicate zero when test lead ends are touched together while ohmmeter is being cranked. | Test leads open circuited. | Correct open circuit or replace test leads. |
| Pointer indicator does not move readily. | Metallic particles collected on moving system magnet. | Collect particles. Exercise extreme care as the moving system can be damaged in the process. |
| Ohmmeter does not calibrate. | Resistance changes, partial short of resistors, and moving system. | Check resistors and moving system. Replace if defective. (See paragraph 5-4d). |

| TROUBLE | PROBABLY CAUSE | REMEDY |
|---|---|---|
| No generator voltage at EARTH and LINE terminals although crank turns easily. | Defective generator. | Check generator assembly. Remove and replace if defective. (See paragraph 5-4c.) |
| No generator voltage at EARTH and LINE terminals (crank does not turn easily) | Shorted capacitor C4. | Replace capacitor. (See paragraph 5-4d.) |
| | Shorted resistor $R_9$. | Remove and replace resistor assembly. (See paragraph 5-4d.) |

TABLE 5-3. CALIBRATION EQUIPMENT REQUIRED

| Nomenclature | Application | Range/Values | Accuracy |
|---|---|---|---|
| Wire Wound Resistor | Supplies known resistance. | 100 Ω<br>500 Ω<br>5 KΩ<br>20 KΩ<br>1 MΩ<br>10 MΩ<br>100 MΩ<br>1000 MΩ | All within 0.1% |
| Ohmmeter | For checking instrument's discharge circuit. | 0 to 200 KΩ (over-Lapping ranges) | 1% |
| Electrostatic Voltmeter | For checking voltage at instrument's terminals. | 0 - 2000 V (over-lapping ranges) | 2% |

5-4. REMOVAL OF PARTS AND SUBASSEMBLIES.
(See Figs. 6.2, 6.3, 6.4 and 6.5)

a. REMOVAL OF CASE COVER. Remove four seals and four screws attaching cover to case, lift off cover.

Remove the guard terminals.

b. REMOVAL AND DISASSEMBLY OF MOVING ELEMENT ASSEMBLY WITH SCALE.

(1) Unsolder three connections.

CAUTION

USE EXTREME CARE NOT TO DAMAGE THE COIL OR THE POINTER.

(2) Remove two screws with lockwashers attaching moving element assembly to chassis (Fig. 6.5B).

(3) Carefully lift moving element assembly out of case.

c. REMOVAL OF GENERATOR. Perform operations in Paragraph 5-4a and b (1) through (3) before attempting to remove generator. (Fig. 6.5B)

(1) Remove four seal cups and lift complete chasis out of case housing.

(2) Disconnect two leads for generator.

(3) Remove scale from moving system.

(4) Remove three screws and lockwashers and lift generator assembly from mounting plate. (Fig. 6.5A)

d. REMOVAL OF COMPONENT BOARD ASSEMBLY RESISTORS AND CAPACITORS. See figure 3. Perform operations in Paragraphs 5-4a, b and c before attempting to remove component board with attaching parts.

(1) Remove four seal cups and lift complete chassis out of case housing.

(2) Remove four screws, spacers, lockwashers, and nuts holding component board to chassis. Remove complete board assembly.

(3) Unsolder defective resistor or capacitor and replace as necessary.

e. REMOVAL OF SWITCH. See figure 6.3. Perform operations in Paragraphs 5-4a, b and c (1), before attempting to remove component board with attaching parts.

(1) Unsolder all connections. Tag all connections for identification.

(2) Remove nut and lock washer. Pull out switch and replace.

5-5. REASSEMBLY OF PARTS AND SUBASSEMBLIES.

a. REPLACEMENT OF COMPONENT BOARD ASSEMBLY.

(1) Solder new components to component board.

(2) Position component board to chassis with four screws, spacers, lockwashers and nuts. See figures 6.3 and 6.4.

(3) Install above completed assembly into case housing and secure with four seal cups.

b. REPLACEMENT OF GENERATOR.

(1) Position generator in case housing and secure with three screws and lockwashers.

(2) Attach two generator leads.

c. REASSEMBLY AND REPLACEMENT OF MOVING ELEMENT ASSEMBLY WITH SCALE.

(1) Position moving element assembly carefully in case housing and secure assembly to chassis with two screws and lockwashers.

(2) Resolder three connections.

d. REPLACEMENT OF CASE COVER.

(1) Position cover on case and secure with four screws.

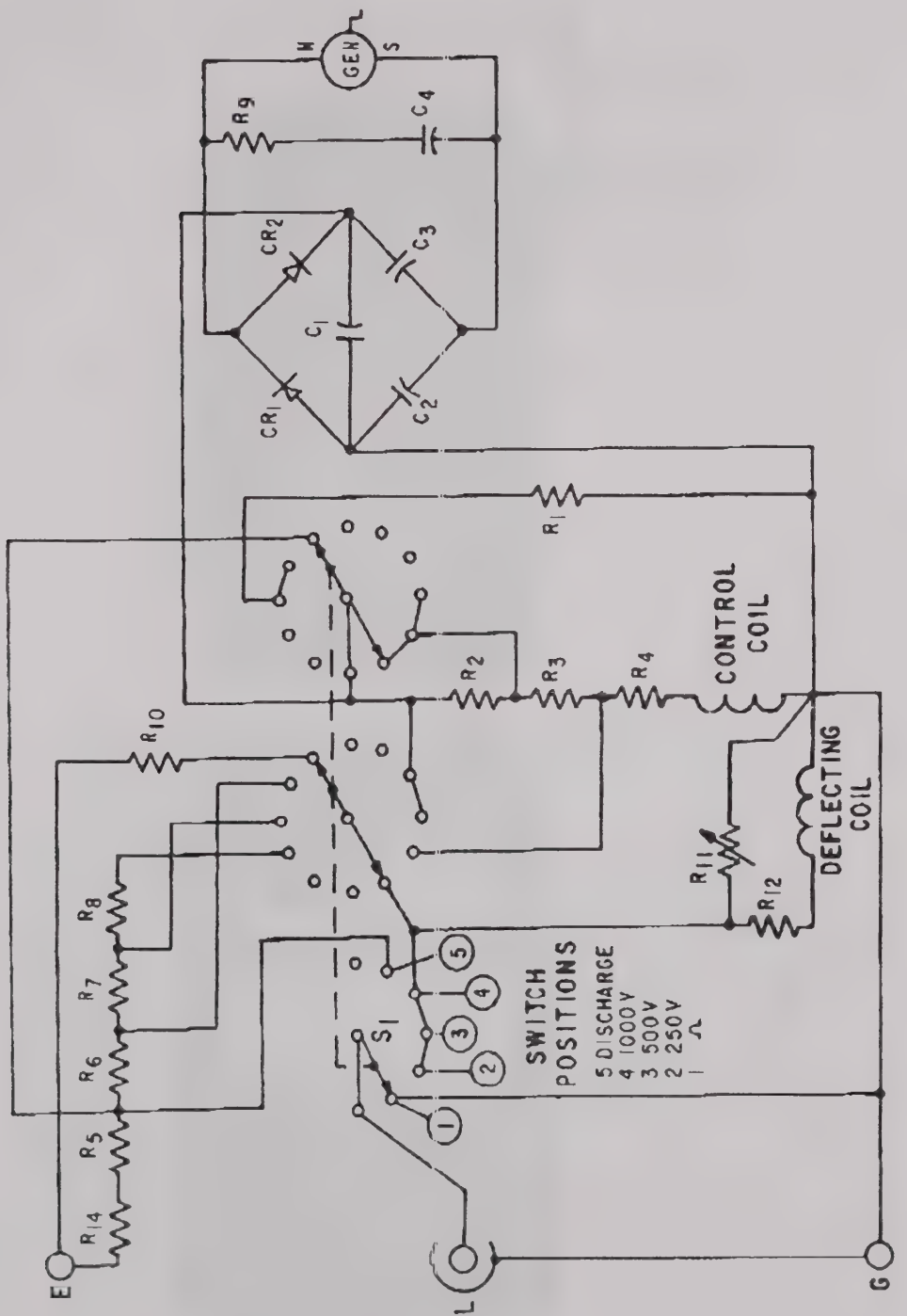



FIG. 6.1 Schematic Cat. 21158 Major Megger Insulation Tester

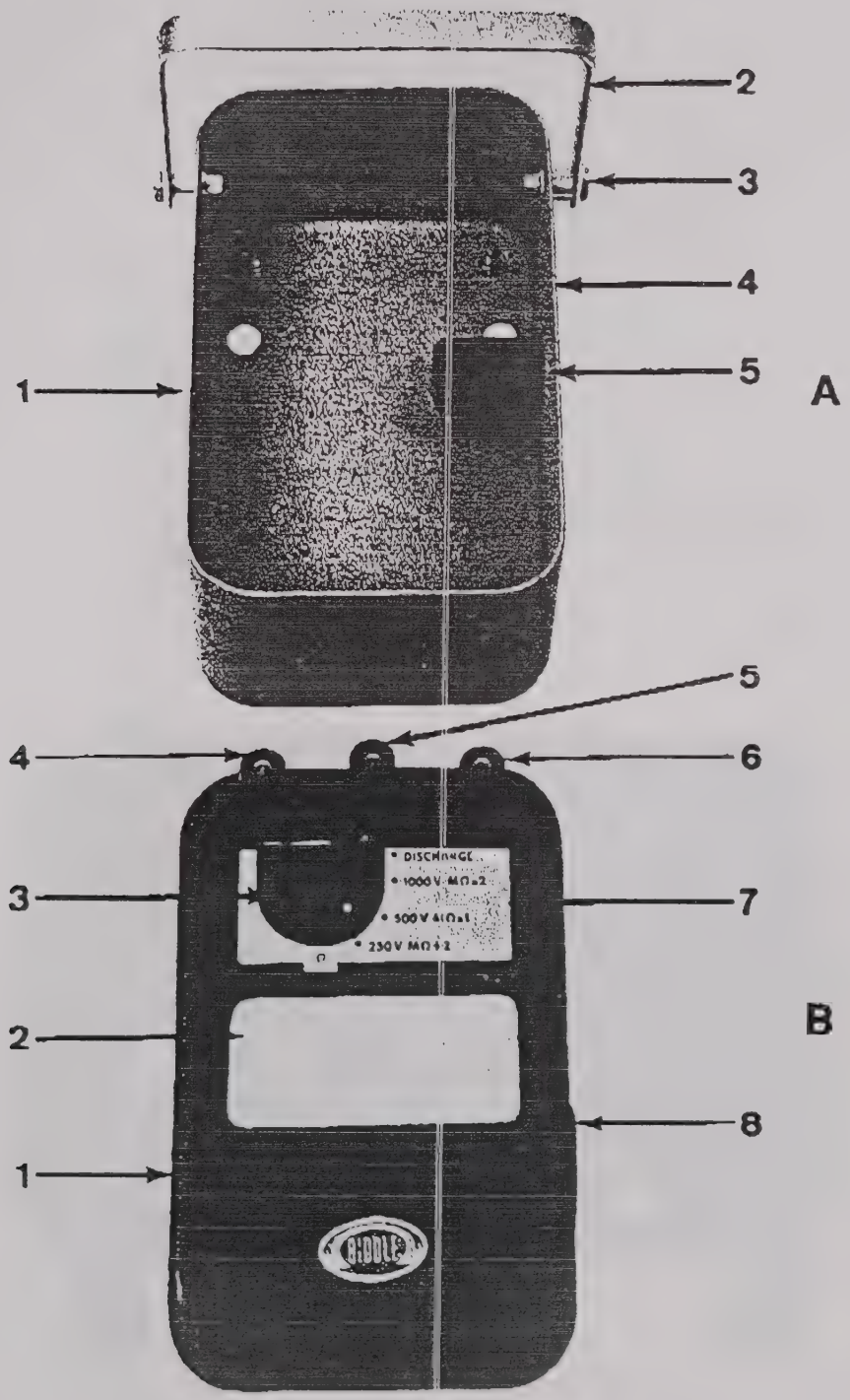



FIG. 6.2 Case Bottom, Case Cover.

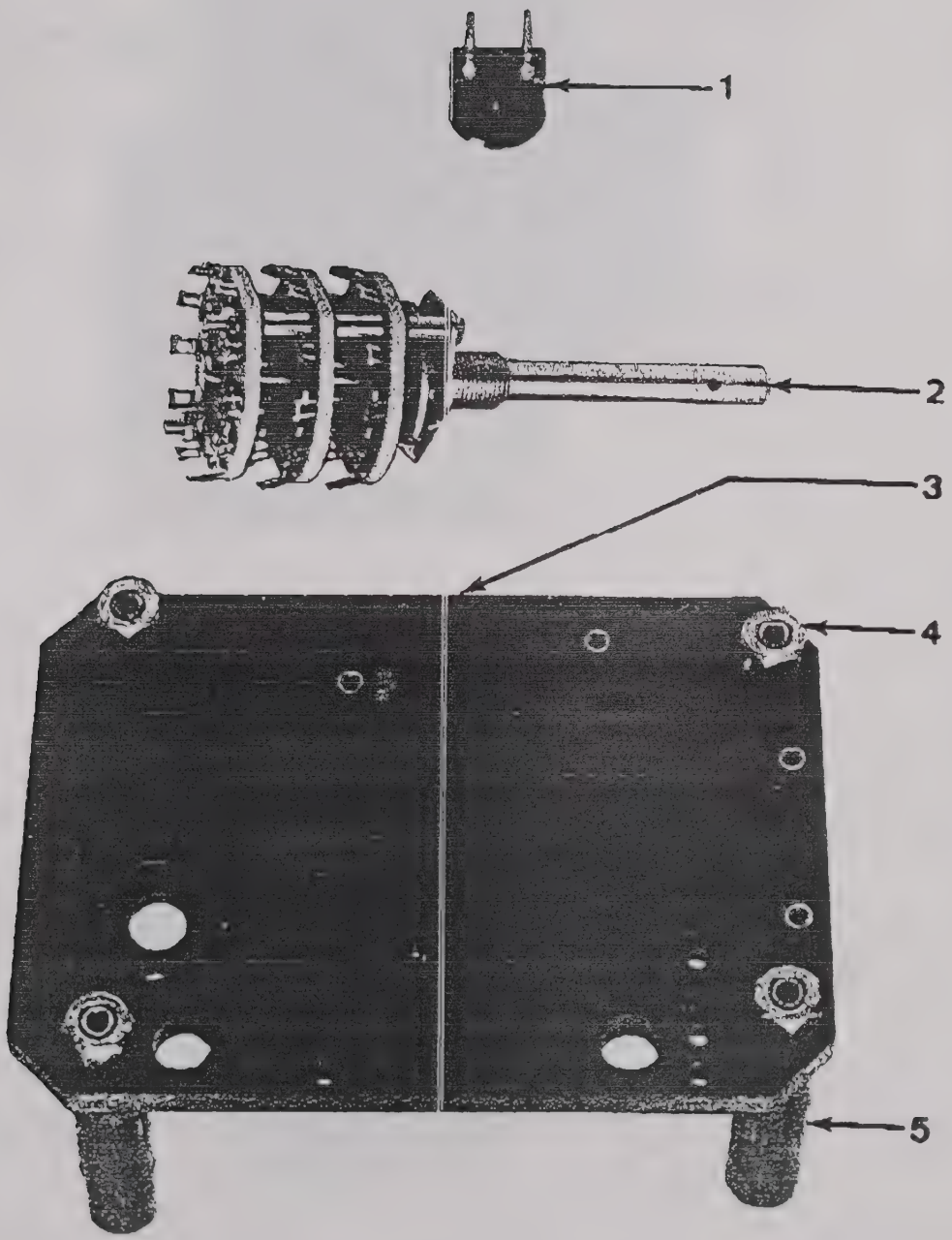



FIG. 6.3 Chassis, Switch and Potentiometer.

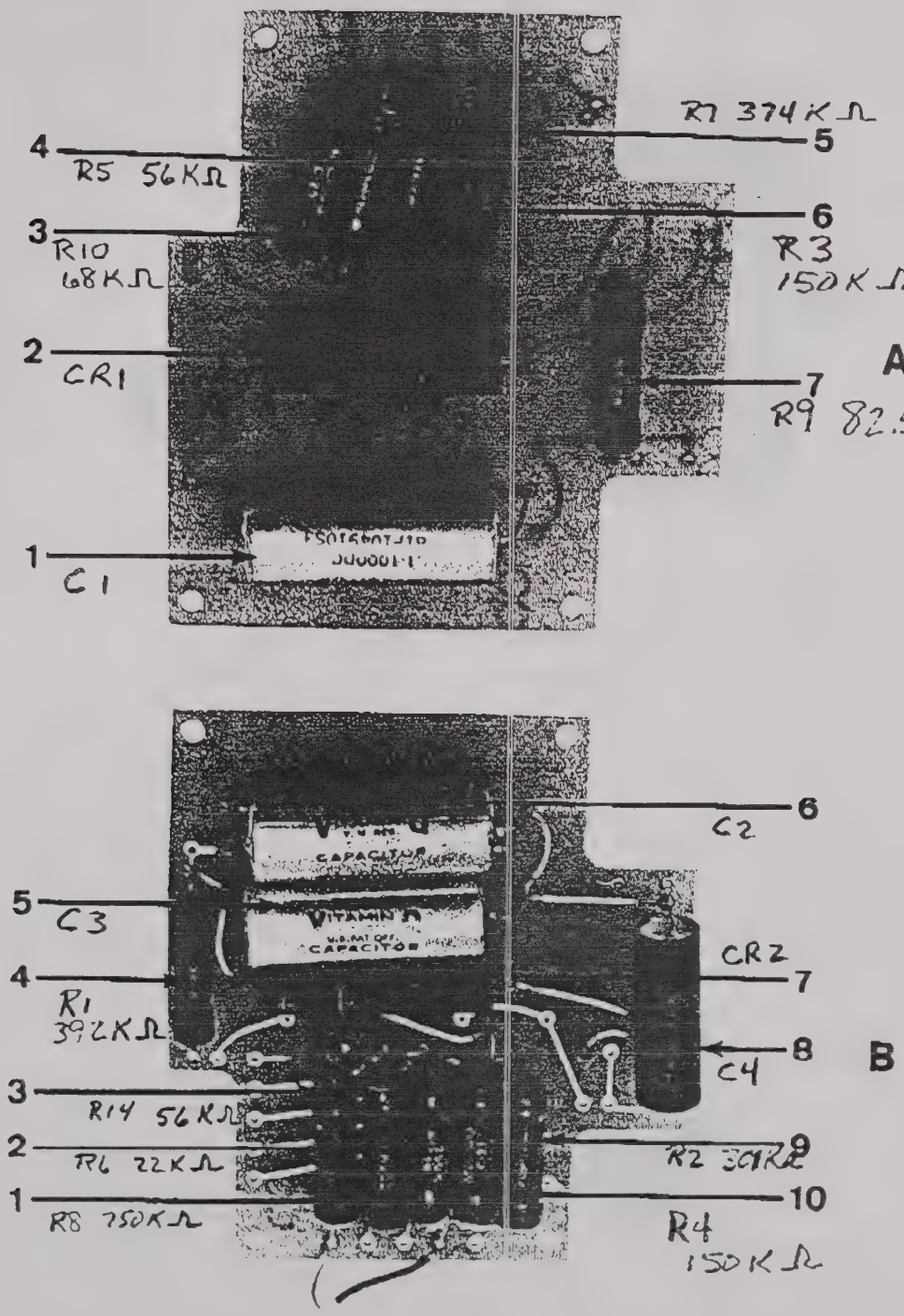



FIG. 6.4 Component Board.

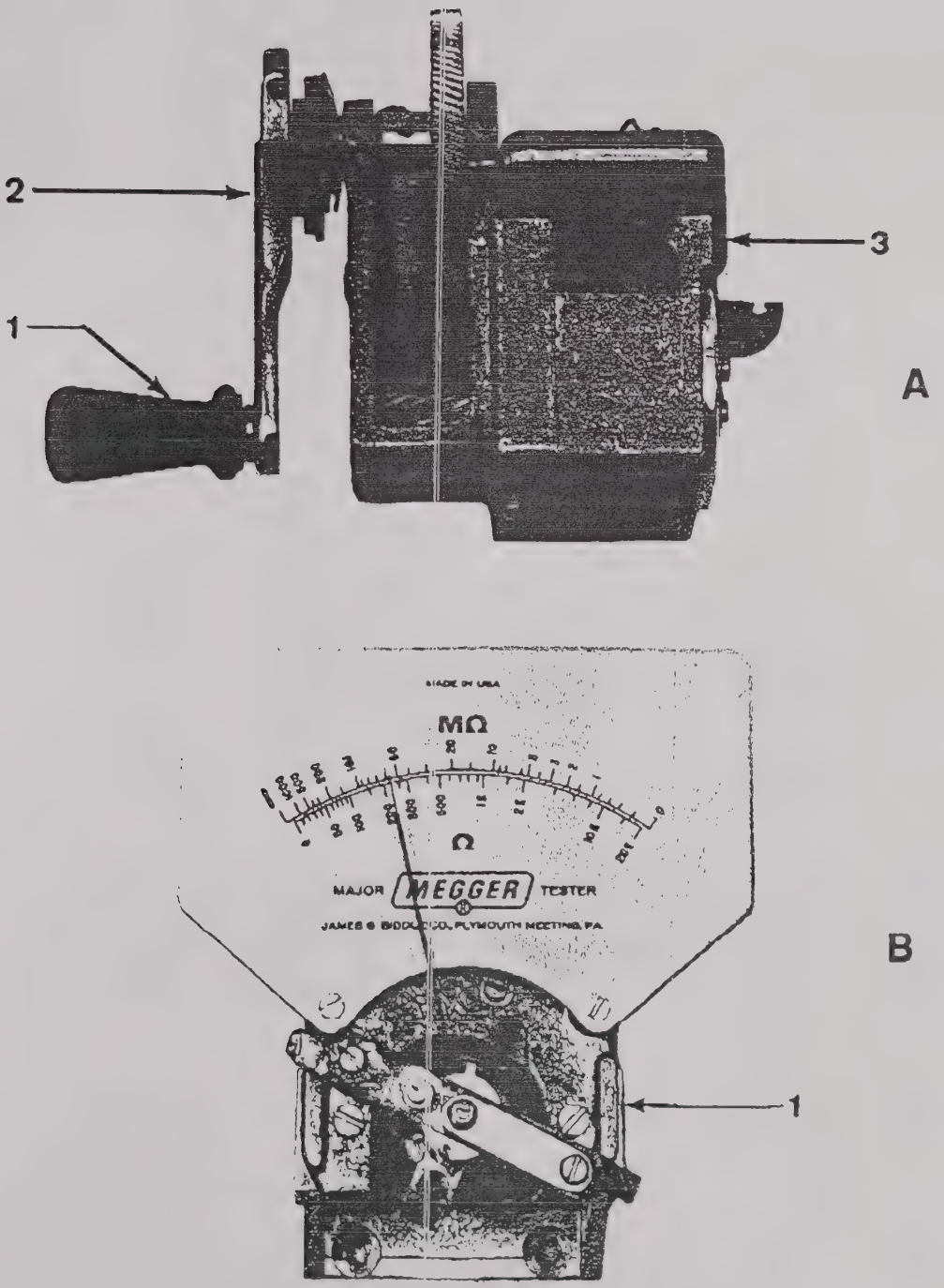



FIG. 6.5 Generator and Moving Element

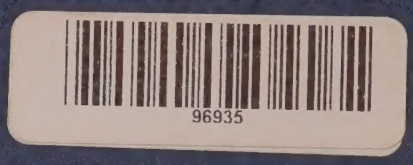
| Reference Designation | Figure Number | Name and Description | Part No. |
|---|---|---|---|
| FIG. 6-2 | | | |
| | | Bottom | |
| A | 1 | Case Assembly Complete (Figure numbers 2, 3, 4, 5 and rubber feet and seal cup) | 4301 |
| A | 2 | Handle, Carrying | 4496-1 |
| A | 3 | Handle, Screws (2 required) | 4497 |
| A | – | Feet, Rubber (4 required) | 6182-2 |
| A | 4 | Case, Bottom, only | 4302 |
| A | 5 | Housing | 4335 |
| A | – | Seal Cup | 4332 |
| FIG. 6-2 | | | |
| B | 1 | Case Cover Assembly Complete (Including window, glass clip and gasket) | 4307-1 |
| B | 2 | Window Glass | 4311 |
| B | – | Window Clip | 4312 |
| B | – | Window Gasket | 4313-1 |
| B | 3 | Range Knob | 4337 |
| B | 4 | Binding Post complete - EARTH | 11166-2 |
| B | 5 | Binding Post complete - LINE | 11166-2L |
| B | 6 | Binding Post complete - GUARD | 11166-2 |
| B | 7 | Range Label | 4494-2 |
| | | Label | |
| B | – | GUARD Binding Post | 4319-2 |
| B | – | LINE and EARTH Binding Post | 4319-1 |
| B | 8 | Case Cover only | 4308-2 |
| FIG. 6-3 | | | |
| | 1 | Potentiometer ($R_{11}$ Schematic Fig. 6-1) | 4353-1 |
| | 2 | Switch - wired | 4323 |
| | 3 | Chassis - only | 4488-2 |
| | 4 | Pillar Nuts (4 required) | 1360-1 |
| | 5 | Pillar (4 required) | 4322 |

| Reference Designation | Figure Number | Name and Description | Part Number | Reference Fig. 6-1 | Resistance Value |
|---|---|---|---|---|---|
| FIG. 6-4 | - | Component Board Complete. Wired. Items 1 to 7 inclusive under Fig. 6-4(a) and 1 to 10 inclusive under Fig. 6-4(b) | 4325 | | |
| A | 1 | Capacitor | 5977-3 | $C_1$ | |
| | 2 | Rectifier | 2538 | $CR_1$ | |
| | 3 | Resistor | 7524-22 | $R_{10}$ | 68 KΩ |
| | 4 | Resistor | 7524-18 | $R_5$ | 56 KΩ |
| | 5 | Resistor | 7524-20 | $R_7$ | 374 KΩ |
| | 6 | Resistor | 7524-16 | $R_3$ | 150 KΩ |
| | 7 | Resistor | 7524-34 | $R_9$ | 82.5 KΩ |
| B | 1 | Resistor | 7524-21 | $R_8$ | 750 KΩ |
| | 2 | Resistor | 7524-19 | $R_6$ | 22 KΩ |
| | 3 | Resistor | 7524-18 | $R_{14}$ | 56 KΩ |
| | 4 | Resistor | 7524-14 | $R_1$ | 392 KΩ |
| | 5 | Capacitor | 5977-3 | $C_3$ | |
| | 6 | Capacitor | 5977-3 | $C_2$ | |
| | 7 | Rectifier | 2538 | $CR_2$ | |
| | 8 | Capacitor | 5977-4 | $C_4$ | |
| | 9 | Resistor | 7524-15 | $R_2$ | 301 KΩ |
| | 10 | Resistor | 7524-16 | $R_4$ | 150 KΩ |
| - | - | Resistor | 7524-17 | $R_{12}$ | 40 KΩ |

± 1% 1 W. rating

| Reference Designation | Figure Number | Name and Description | Part No. |
|---|---|---|---|
| FIG. 6-5 | | | |
| A | 1 | Crank Handle Knob | Z 240 |
| A | 2 | Crank Handle Assembly | RZ 35466/02 |
| A | 3 | Generator Assembly complete | 4333-3 |
| FIG. 6-5 | | | |
| B | 1 | Moving System complete with calibrated scale | 4330-5<br>4334-2<br>Calibrated |

Oxford®
ESSELTE
10%


96935

www.manualsplus.com
1000003